(19)JAPANESE PATENT OFFICE (JP)

(12) **OFFICIAL GAZETTE FOR LAID-OPEN PATENT (A)** (11)Publication Number of Patent Application 5-83923

(43) Publicized on April 2, 1993

(51) Int.Cl. 5	Identification Mark	In-house Reference No.	F1	Technique Indicating Place
H 02 K 41/025		A 7346-5H		

Request for Examination: Not made

The Number of Claims: 2 (4 pages in all)

(21) Patent Application No.1991-267023

(22) Filing Date September 17, 1991

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(54) [Title of the Invention] Single-Layer Winding Linear Induction Motor

(57) Abstract

[Objective] It is an objective of the present invention to provide for a single-layer winding linear induction motor which is designed to achieve energy saving and cost reduction in its manufacturing process.

[Construction] The motor according to the present invention comprises a stator and a movable element arranged oppositely to the stator through a void, and the stator 30 is provided with tooth portions 30 in an iron core, a yoke portion 41, and coils 51 in which their material wires are turned about the tooth portions 31 alone. The tooth portions 30, the yoke portion 31 and the coils 51 are respectively formed as a separate unit. The yoke portion 41 has the tooth portions 31 successively fixed longitudinally thereof

at predetermined intervals of place, with the coils 51 mounted thereon.

[Claims]

[Claim 1] A single-layer winding linear induction motor comprising a stator and a movable element arranged oppositely to the stator, characterized by that the stator is provided with a plurality of tooth portions in an iron core, a yoke portion, and a plurality of coils in which each material wire is turned about a single tooth portion in an iron core, the tooth portions, the yoke portion, the coils being formed as separate bodies by press-blanking silicon steel plates to attach the respective resulting blanks one on top of one another so that the tooth portions, the yoke portion and the coils have predetermined thickness, and that the tooth portions mounted with the coils in their yoke portion are successively fixed longitudinally of the yoke portion at predetermined intervals of place.

[Claim2] A single-layer winding linear induction motor as set forth in claim 1, wherein the tooth portions in an iron core are respectively formed with ear portions at their ends in the direction which intersects at right angles with the longitudinal direction of the motor.

[Detailed Description of the Invention]

[0001]

[Industrially Applicable Technological Field] The present invention relates to a single-layer winding linear induction motor.

[Prior Art] A conventional single-layer winding linear induction motor will now be described by reference to the drawings. Figure 3 is a front-elevational sectional view which shows a part of a stator. Figure 4 is a planar sectional view of the same part as shown in Figure 3. Figure 5 is a plan view which explains a press-blanking method to

form an iron core.

[0003] The single-layer winding linear induction motor is formed by a stator 10 and a movable element (not shown) which is mounted oppositely to the stator 10. As shown in Figures 3 and 4, the stator 10 comprises an iron core 11 and coils 21 in which the material wires are wound thereto, or which are inserted therein. The iron core 11 of the stator is formed with tooth portions 13, groove portions 14, and a yoke portion 15. The coils 21 are identical to one another in their sizes, the numbers of turns, and the winding directions, and in order to mount each tooth portion with the coil, the material wire of each coil is wound to a single tooth portion 13, or the coil itself is put on a single tooth portion 13 such that the tooth portion 13 pass through the coil in appearance. Predetermined electric connections are performed upon the respective terminals of the coils 21.

[0004] Figure 4 shows a three-phase, six poles and star connection type stator. The tooth portion 13 is provided with a concave recess 16 adjacent to its end portion in the direction in which it is opposite to the groove portion 14, or, in the direction in which it intersects at 90 degrees with the longitudinal direction of the motor. This arrangement prevents any rise of the coils 21 with an aid of a wedge 17. An opening 18 has a stator fixing means (not shown) inserted therethrough.

[0005] The iron core 11 is produced as described hereinafter. As illustrated in Figure 5, a silicon steel plate is press-blanked to form the teeth portions 13 of predetermined dimension, the groove portions 14 which alternately adjoin the tooth portion 13, and a yoke portion which connects the tooth portions 13 integratedly therewith. This press-blanking operation is repeated to obtain a plurality of blanks thus formed with the respective component portions of the iron core, and such blanks are attached one upon

top of one another such that they have predetermined thickness.

[0006] The excitation of the coils 21 generates a moving magnetic field, and this creates thrust upon the movable element. The movable element is arranged to allow this thrust to transport a transporting object loaded thereon. In general, supposing that the air-gap magnetic flux density of the linear induction motor remains constant, the thrust introduced in the movable element is substantially proportional to the overlapping area of the movable element with the opposite stator, and in a small-sized linear induction motor equipped with an iron core, a starting thrust of 30N to 50N is obtained for 1kVA of input. Moreover, the length, input and other conditions of the motor vary according to the transporting object, and therefore, the iron core for the stator, and the coils are separately designed and manufactured each time the transporting object is changed.

[0007]

[Task to be Solved by the Invention] However, the aforementioned variation in the length, input and other conditions of the motor according to a change in the transporting object does not allow any mass production of the motor. Therefore, the designing and manufacturing of the motor are executed in response to separate demands, and this raises problems in which a great number of manufacturing processes are necessitated, and the manufacturing time. is extended. Also, the overall length of the motor, or that of the stator is restricted, depending upon the dimension of the existing insulating equipments in which a mold is used to cover the insulating object with an insulating resin, and this results in the inability to manufacture any large-sized massive motor. Moreover, when a silicon steel plate 12 is press-blanked to obtain the iron core 11 for the stator, the plate is partially scraped in its places which

correspond to groove portions 14, namely, the coils 21 receiving portions. This also causes a problem in which the material of the iron core is made, and the manufacturing energy are wasted or lost. In view of the disadvantages described in the foregoing, the present invention is created, and it is an objective of the invention to provide for a single-layer winding linear induction motor for which the designing and manufacturing time is reduced, while at the same time, a resource saving effect and an effect to decrease the manufacturing cost are obtained.

[0008]

[Task Solving Means] The single-layer winding linear induction motor according to the present invention comprises a stator and a movable element located oppositely to the stator, and is characterized by that silicon steel plates are press-blanked to form a plurality of blanks for the stator which are respectively provided with a plurality of tooth portions, a yoke portion, and a plurality of coils in which each material wire is wound to a single tooth portion, such stator blanks are piled up such as to have predetermined thickness, and the tooth portions mounted with the coils at their yoke portion are successively fixed longitudinally of the yoke portions at predetermined intervals of places. The tooth portions are formed with ear portions at their end portions in the direction which intersects at right angles with the longitudinal direction of the motor.

[0009]

[Preferred Embodiments of the Invention] A preferred embodiment of the present invention will now be described with reference to the accompanying drawings. Figure 1 is a partially cutaway perspective view of a stator. Figure 2 is a front-elevational view of an iron core for the stator. Any portions identical to those of the conventional

single-layer winding linear induction motor are shown with the same reference numerals as given to the conventional motor of the same type.

[0010] The single-layer winding linear induction motor according to the present invention (hereinafter referred to as the motor of the invention) comprises a stator 30 and a movable element (not shown), and the stator 30 are made of blanks which are formed as separate units of a plurality of tooth portions 31, a single yoke portion 41 and a plurality of coils 51. The tooth portions 31 in the iron core can be identified as those which are obtained by separating them from the conventional iron core 11 for the stator .

[0011] As shown in Figure 2, in order to produce the tooth portions 3, a single silicon steel plate 12 is press-blanked to form only the tooth portions in a predetermined configuration such that they successively range at regular intervals of place. This press-blanking operation is repeated to obtain a plurality of blanks thus formed with the tooth portions, and these blanks are attached one on top of one another by means of epoxy resin such that they have predetermined thickness. These tooth portions 31 are provided with outwardly protruding ear portions 32 at the ends of their both sides. Also, the tooth portions 31 are protuberantly formed with dovetail tenons 33 in a wedge-shaped configuration at their base portions. In Figure 2, the hatched portions 34 between every two adjoining tooth portions 31 are scrap which results from the press-blanking operation.

[0012] A yoke portion 41 can be identified as a remaining portion which results from the removal of the tooth portions 13 from the conventional iron core 11 for the stator. This yoke portion is formed as a separate body from the tooth portions 31 described in the foregoing. A single silicon steel plate 12 is press-blanked substantially as described for

the tooth portions. This press-blanking operation is repeated to obtain a plurality of blanks thus provided with the yoke portions, and these blanks are fitted one on top of one another such as to have predetermined thickness. The yoke portion 41 is longitudinally formed with dovetail grooves 42 at regular intervals of place, which have the dovetail tenons 33 fitted in them. Each coil 51 is identical to the conventional coil 21, and the material wire of the coil is turned about each tooth portion 31, or the wire in a coil-shaped configuration is put on the tooth portion 31 such that the tooth portion 31 has the coil-shaped wire located thereabout.

[0013] Next, the stator 30 assembling procedure will be described. A single tooth portion 31 in the iron core is mounted with a single coil 51 by turning the material wire of the coil about the tooth portion or by putting the coil on the tooth portion such that the coil is located about the tooth portion. Subsequently, an insulating treatment for which a mold is used is applied to the stator assembly thus completed, whereby the coil unit 52 in the iron core is formed. The ear portions 32 prevent any rise of the coil 51 from the tooth portion, and therefore, any wedge in use for the conventional iron core is not needed. Next, the dovetail tenon 33 is fitted into the dovetail groove 42, and the coil unit 52 in the iron core is thus fixed on the yoke portion 41.

[0014] The excitation of the coil 51 allows the movable element to advance and retreat as in the conventional linear induction motor. In order to change the technical specifications such as the length, input and output, synchronous speed of the motor, and other conditions according to a change in the transporting object, it is only needed to alter the length of the yoke portion. That is to say, only required is the insertion of a necessary number of coil units 52 into the yoke portion 41. Thus, alteration of the length of the yoke portions allows speedy production of a variety of single-layer winding

linear induction motors which differ in the technical specifications such as given in the foregoing.

[0015] The method for the fixation of the blanks formed with the tooth portions 31 to those of the yoke portion 41 is not limited to the preferred embodiment of the present invention which is presently described. The blanks of the tooth portions may be fixed to the yoke portion blanks by means of bolts and nuts or the like. Also, the coil unit 52 in the iron core may be formed by mounting the tooth portions 31 with the coils 51 produced separately from them, with a mold type insulating treatment applied to them.

[0016] As described in the foregoing, in the motor of the present invention, the tooth portions 31, the yoke portion 41 and the coils 51 which together form the stator 30 are separately produced as independent units, and therefore, the following effects can be obtained.

①It is easily feasible to change the length, input and output, and other technical specifications of the motor, and therefore, the term for manufacturing the motor can be shortened, and reduction of manufacturing cost can be achieved.

②It is feasible to form the tooth portions at smaller intervals of place by press-blanking, and therefore, material saving and energy saving can be obtained.

③The tooth portions in the iron core, and the coils are much smaller in dimensions than the whole of the motor, and this allows separate applications of an insulating treatment in which a mold is used to cover the insulating object totally with an insulating resin to the tooth portions and the coils. For this reason, any large-sized equipments for this insulating treatment is not necessitated.

④Any assembly of the motor is feasible in conformity to its length at the installing field, and therefore, any dimensional field-adjustment can be facilitated for installation of

the motor.

[Brief Description of the Drawings]

[Figure 1] A partially cutaway perspective view of the stator according to the present invention.

[Figure 2] A front-elevational view of the iron core for the stator according to the present invention.

[Figure 3] A front-elevational sectional view which shows a part of the stator according to the prior art.

[Figure 4] A planar sectional view of the stator according to the prior art.

[Figure 5] A plan view which explains a method for press-blanking a plate to form the iron core according to the prior art.

[Explanation of the Reference Numerals]

12 Silicone steel plate

30 Stator

31 Tooth portion in the iron core

41 Yoke portion

51 Coil

52 Coil unit in the iron core